SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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...N—ITS COMMERCE AND APPLICATION TO STAPLE MANUFACTURES.

BY CHARLES SANDERSON, ESQ.

...e importance of the manufacture of iron, as a metal required for the ...s wants of mankind, has called forth the energies of the chemist and ...echanic. It is not found in a metallic state. Nature has mixed the ...f this metal with a vast variety of substances, from which it is ne...y to separate them before they are serviceable for useful purposes.

...e ores principally used for the production of iron are before you: the ...oxides, being generally a mixture of the per and protoxide; the peroxides, which ...e many varieties, as hematite, hydrates, &c.; the sparry carbonates, or steel ore; ...e earthy carbonates, which are so largely found associated in the coal.

...not necessary for me to give you any detailed account of the localities of these ...ds, because this has been recently laid before you, and their geological position has ...ally treated. I may briefly remark, that the black oxides and hematites being ...ich in metal, are principally smelted with charcoal as a fuel, whilst the earthy car...s are reduced with coke or coal.

...period at which iron was first produced is lost in the most remote antiquity. At ...it would consume too much time were I to trace the progress which has been ...from the earliest known mode of production up to the colossal means now em... Possibly it might be a very interesting investigation, but is certainly not ne...y to our present enquiry.

...allurgy is a science of vast extent in its application, and in its practice draws ...upon the researches of the chemist and mechanic. Whilst geology and mine...direct the enquirer where he may hope to discover the hidden treasures of the ...they shed a light upon that information which leads to a knowledge of their posi...ed the state in which they are found; chemistry enables the metallurgist to ascer...th the quantity and the quality of those substances which nature has mixed up ...e metal, and it opens a wide and interesting field of investigation, in what man... metal may be obtained in a useful state, at the lowest possible cost; and mecha...nowledge lends its aid, in the construction of those machines which are required, ...y to enable the miner to obtain the ore and fuel, but also to reduce the cost of the ...sent manufacturing operations.

...ngland, these acquirements have been attained in so high a degree, and the appli... of scientific knowledge has been so successful, that our iron-works now stand ...at once of intelligence and ingenuity.

...progress of the manufacture of iron, from the earliest period to the present time, ...n marked by the diligent researches of men of high capacity, whose united efforts ...roduced the comparatively perfect system we now employ.

...immense iron establishments of England stand pre-eminent, both as regards the ...nical skill which they display, and the practical management which is continually ...d. Machinery is made to produce economy in every department, and a result is ...btained which appears to defy the competition of other countries. Intelligence ...dustry at home have enabled us to afford our products at so cheap a rate, that our ...e found a market in every civilised country. If the produce of the soil be looked ...s the greatest source of national wealth, doubtless the metallurgical products of ...ngdom stand next in importance, and influence the rise and progress of this wealthy ...werful nation—due to the industry, perseverance, and acquired knowledge of a ...tion whose energies turn to account our mineral riches, by exercising that untir...ergy which marks so prominently the English character.

...ill not enter upon a detailed account of the manufacture of iron, which has been so ...explained, yet I shall be obliged to notice, as I proceed, a few of the processes, be... I shall have to remark upon their present state of perfection.

...a in the immense laboratory of the blast-furnace that the first operations are car...n for the production of pig-iron. Iron-ore, fuel, and fluxes are charged into the ...of the furnace in such proportions as shall secure as pure a crude metal as possible. ...first important step is to ascertain the average contents of the ore, which will be ...to consist of certain earths combined with the metal, usually in a state of oxide ...or oxide combined with carbonic acid. These earthy matters are not found natu...mixed together in such proportions as to secure their fusion—or perfect vitrification, ...from metallic matter. When, therefore, chemical analysis has given the quantity ...uality of the earthy contents of the ore, other substances are added, in such propor...as will secure a perfect vitrification of the whole in their passage through the blast...e; these are called fluxes.

...e ores are generally roasted, to open the mass, render it more porous, and at the ...time to volatilise the sulphur, phosphorus, or arsenic with which they may be com...These ores, in a state of peroxide, are charged into the furnace, in certain pro...ns, along with the fuel and the fluxes.

...examining the chemical changes which take place in a blast-furnace, it is very ex...inary that the theory given by Professor Bunsen and Dr. Lyon Playfair has received ...e consideration. The various gases which are produced in the different zones of ...nace have been collected and examined, and their action and reaction have been ...ified by practical results, that it appears as though no doubt could exist upon the ...t, and although chemical principles are clearly set forth, as regards the causes ...effect the changes which take place in blast furnaces, yet they, nevertheless, be...modified in furnaces differing in form, as well also from the nature of the ores, fuel, ...xes used.

...ill first examine the changes which take place in the passage of each charge of ore, ...and flux, in its descent from the mouth of the furnace to the dam beneath. I will ...ay before you the effects produced by the action of the blast upon the fuel, show at ...points the various gases are produced, and how by their action upon the ore it be...changed; thus explaining, as nearly as possible, the rationale of the reduction of ...e into metal, and the union of the earthy matter with the flux forming the slags. ...iron ore is charged into the furnace as a calcined peroxide. Limestone is added as ...to unite with the earthy matter which the ore and the fuel may contain. During ...r six feet of their descent, the moisture is expelled; they then become gradually ...d to redness, and are prepared for reduction in the first zone of the furnace. Here ...e loses a portion of its oxide, and becomes reduced to a protoxide. These materials ...nter the second zone, which ends at the boshes, or widest part of the furnace. At ...oint the ores are not only completely deoxidised, but become partially cemented. ...mestone also has now parted with its carbonic acid, and the alkaline portion unites ...other earthy matter, together forming a slag. The whole gradually, but slowly, ...ds through this part of the furnace, which is made wider, in order that the mate...may take a longer time in passing through this space, thus leaving them for a longer ...subjected to the action of the carbon. The metallic portion becomes gradually ...pped, and acted upon by the carbon of the fuel, and the highly-carbonising gases ...it meets with in the lower region of the furnace. It then passes the direct ac... of the blast at the tuyere, and falling into the dam, separates itself, by its superior ...ic gravity, from the vitreous earthy matter which covers it, and protects it from ...idising influence of the blast. Such are the changes which each charge undergoes ... passage through the furnace. I will now examine the cause of these changes.

...e air which is blown into the furnace is composed, in round numbers, of 79 nitrogen ...d oxygen. Before this air has risen 3 feet from the tuyere, it is converted into 65 ...en and 27 carbonic oxide; the nitrogen combines with a certain portion of carbon ...m cyanogen, and the potassium which is obtained from the fuel, and sometimes ...the ore and flux, unites with it, forming cyanide of potassium. The cyanogen is ...ed by the union of the nitrogen of the air blown into the furnace, with a portion of ...arbon obtained from the fuel, which, uniting with the potassium, is driven through ...aterials contained in the furnace, rapidly deoxidising the ore in its passage, and ...ally resolving itself into nitrogen, carbon, and carbonate of potash, the former, as ...escaping at the mouth of the furnace, and the latter, which is not volatile, uniting ...the descending column of materials, and, reaching that region in which cyanogen ...duced, is again transformed into cyanide of potassium. The strongest deoxidising ...r is exerted as far as 6 ft. to 7 ft. above the tuyere; it then diffuses itself as it rises ...gh the mass of matter found in the boshes. So long as it retains that high degree ...t at which it is volatile, being carried up along with the ascending current of ..., it exerts this strong reducing power, and becomes gradually decomposed; thus, in ...econd zone the carbonic oxide becomes the principal cementing medium, whilst in ...rst zone this gas, combined with a light carburetted hydrogen which is evolved, ...uences the decomposition of the iron ore.

...m this theory it will be seen that the heat obtained in a blast furnace is generated ...lowest region, since we find that at 3 ft. or 4 ft. above the tuyere all the oxygen ...ed is actually absorbed, giving rise to highly heated reducing gases, which, by the ...re of the blast, are in a manner forced through the furnace.

...all the theories which have been advanced respecting the cementation of the ores ...ed in the blast furnace this very important action of the cyanide of potassium has ...neglected; yet from the first blowing in of the furnace it exerts an active decom... influence, and as the furnace continues to work and the potassium to accumulate, ...olume of cyanogen becomes necessarily increased, and although formed in the hottest ..., its influence spreads over a large portion of the lower part of the furnace, and this ...s the theory of what in practice is called getting the furnace into good working ...

Such is the theory of those changes which take place in blast furnaces during ...ocess of smelting.

...regards the construction of furnaces, generally speaking, they should have an inter...m favourable to the gradual reduction and diminution of the volume of materials ...ed, which it is important should be so mixed that the earthy matter of the ore and ...x may readily unite; the descent of the materials in the furnace is regulated by ...clination and width of the boshes, and necessarily this inclination or width varies according to the nature of the ore which is to be smelted—those which are most easily reduced require the boshes to be the most inclined, whilst those which are difficult of reduction, and consequently require to be subjected to the action of the carbon of the fuel and the gases which are generated, for a longer period, are retained in this part of the furnace by greatly increasing its width, and giving the boshes a greater inclination.

In explaining this action of the blast-furnace, I have shown how the metal is reduced and carbonised, from which it will appear how difficult it is to obtain a pure metal, because, as it becomes developed in the lower regions of the furnace, it is necessarily mixed with substances forming a variety of metalloids; besides which, it is mechanically associated with the slag, which protects it in the dam from the oxdising influence of the blast, through which it descends, carrying also with it a mixture of unreduced matter, which, from its gravity, becomes more or less mixed with the metal when it is in a state of pig-iron.

Although the blast-furnace is the most effective and also the most economical for reducing iron ore, yet we find that there is an actual loss equal to 80 per cent. of the effectual usefulness of the fuel. This fact is arrived at from the theory I have laid before you of the formation of gases in the furnace, taking the melting point of pig-iron at 2192 Fahr. The fuel, used together with the blast injected into the furnace, will give the quantity of carbonic oxide, light hydrogen, &c., which, when burned with heated air, would be sufficient to reduce or melt a given weight of iron from its ore, which in theory is estimated at between 16 and 17 per cent. of the value of the fuel consumed. These gases, so largely produced, are now collected in many works by means of pipes variously arranged, and inserted a few feet below the mouth of the furnace. They are used mixed with a certain portion of atmospheric air, as a fuel for raising steam, heating the blast for the furnace, and on the Continent for the purpose of puddling; also for drying and carbonising the ore prior to its being charged into the furnace. If these gases are taken as they arise from the furnace, I see no objection to their being applied to useful purposes, but I do object to even the least forcible means being used to draw them from it. No current ought to be created in any apparatus which may be formed for conveying away these gases, since it would cause them to pass too rapidly through the furnace, and thus prevent them from producing their full effect upon the materials through which they are made to pass. This utilisation of the waste gases is highly interesting and presents a wide field for application, besides which there is an evident economy to be obtained from their use, provided they are properly withdrawn from the furnace.

In the reduction of iron ores, it is very important to obtain the resulting metal in a state as free from deleterious matter as possible. To effect this, the ore is roasted to disengage all volatile matter and disintegrate the mass, such fluxes being used as shall, in the process of smelting, form vitreous compounds, by entering into combination with the earthy matter contained in the ore and fuel. Instead of giving any chemical formula, in order to show the relation one earth has to another, or the exact proportions of each which are required to form slags of sufficient fluidity, I will suppose that an iron ore be taken of a silicious nature and smelted alone, the result would, of course, be a silicate of the oxide of iron, like finery cinder. We will look upon this combination as that of an acid with its base, the acid being combined with the oxide of the metal. In order to liberate the metal, this combination must be decomposed by some other alkaline bases which have a greater affinity for the acid, and unite with it, forming new compounds, at the same time liberating the metallic oxide; so it is in the blast-furnace. Iron ores become soft during the process of deoxidation, they eventually melt, and in that state require to be in immediate contact with one or more alkaline bases, so that they may prevent the formation of the silicate which would otherwise take place. Limestone is the matter used for this purpose; it is well adapted to the object, but, in my opinion, the large amount of carbonic acid which it contains is prejudicial, because, in its descent, large volumes of this gas are given out, which absorb a large portion of the heat from the materials in the furnace, thus cooling the region where such absorption takes place, and often producing very serious derangements in the working of the furnace. Since a certain amount of alkali is required to saturate the silicious matter, that object would be best attained by introducing such alkali in as condensed a form as possible. I am, therefore, a strong advocate for the use of caustic lime instead of limestone, because the carbonic acid which forms 40 per cent. of the bulk is not wanted, and it is a waste of fuel to heat so large a mass of what may be called sterile material. Salt has been proposed as a flux; in small doses it will be found very beneficial.

Sir Francis Knowles, struck with the functions of the cyanide of potassium, proposes to introduce potash, felspar, or soda into the furnace charges; he adds lime, equal to two-thirds of the weight of the silica contained in the felspar; the bases then become lime, alumina, and the alkali, which being in excess, is released to form the cyanide required; he states that his trials have given him a cinder entirely free from iron; he has also patented the use of kaolin, or china clay, as a flux; this substance consists of 47 per cent. alumina, and 52 per cent. silica, so that even when the silica is neutralised there yet remains 30 per cent. of alumina to act upon that contained in the ore; kaolin is thus much superior to shale, which only leaves about 10 per cent. of free alumina after the silica is neutralised. I believe some experiments are now going on to smelt forge cinders with kaolin, and, if they are successful, this substance may be beneficially applied to all silicious ores. He further proposes to deoxidise the rich ores prior to their being charged into the blast furnace, by charging them into large retorts heated cherry red, and passing through them a current of carburetted hydrogen gas, which he obtains from the coke ovens; he finds that peroxides can be thus converted into protoxides in two hours, and that in three or four hours they assume the appearance of metallic iron; ore so prepared, he states, will at once go down as grey iron on arriving at the boshes; as an economical means of carbonising the ore, he takes the waste gases of the furnace and passes them in a highly heated state through the fuel to be coked; the gases evolved are stored in a gasometer for use.

Many ingredients have been, from time to time, proposed for improving the quality of crude iron, but acting as they do upon so large a mass of matter, but little benefit has yet been derived.

The pig-iron which is produced from blast-furnaces varies in quality—that is, the iron is more or less mixed up with matter which is not metallic, whilst the iron itself contains more or less carbon. In charcoal furnaces, in which the rich ores are generally smelted, and in which the fuel is not so strong as coke to withstand the strong blast, or the superincumbent pressure of the ore, great care is required in adjusting the burthen of the furnace; if a heavy burthen of ore be used, with a view of obtaining cheap pig-iron, using only a small portion of fuel, it is very evident that the ore will pass too rapidly through each region of the furnace; it thus retains and carries with it a large portion of deleterious matter, and but a small dose of carbon; such metal is thus unfit for casting purposes, and when manufactured into malleable iron produces much waste, and retains all the bad properties which the metal contracted in the blast furnace.

The trade divides the qualities of pig-iron into numbers 1 to 4; the more carbon it contains the more fluid it becomes on melting. No. 1 is that most highly carbonised; 2, 3, and 4 contain each a less degree of carbon, whilst the common white iron contains only a small portion, having been made to pass too rapidly through the furnace, and consequently become mixed with much deleterious matter. Nos. 1 to 3 are principally used for casting purposes, whilst No. 4, and all metal less carbonised, is used for the manufacture of rails, and common malleable iron.

There has been much controversy as respects the relative strength of hot and cold-blast iron; I do not propose to give at length the reasons alleged by the supporters of the superiority of either kind; but I wish to observe that, inasmuch as iron becomes stronger in proportion as the metallic molecules of which it is composed are brought close together, it appears to me most probable that pig-iron produced by cold-blast, and under such circumstances as to ensure the production of the purest iron, would be most likely to produce the strongest material for casting purposes. With this theory, as regards the strength of iron, I must at present leave this most important matter, although much more might be said upon a question which has been too often the cause of serious accidents, but which involves so much minute enquiry that my time will not allow me to say more than to express the opinion, that pig-iron may be materially improved for casting purposes, and made much stronger for mechanical and engineering objects, as well as the no less important purpose of ordnance. I base this opinion upon the theory I have just advanced, that iron increases in strength in proportion as the molecules of the metal are brought closer in contact, without producing crystallisation; and this can only be effected by discharging a large portion of that deleterious matter with which the metal becomes associated during its production in the blast-furnace, and as iron for casting purposes can be thus improved, its application will be materially increased.

In the foregoing, I have endeavoured to explain the theory of the production of pig-iron in the blast-furnace, and, at the same time, have endeavoured as far as possible to make this theory agree with every-day practice, although I have condensed the subject into the smallest space, yet I feel how very little my time has allowed me to lay before you, upon the manufacture of a metal which finds employment for so large a portion of our population. The plans which have been proposed for the utilisation of the waste gases are a subject of great interest, since this is the only step which has been made to recover the effect of that fuel which is now lost. The relative effects of coal as a fuel, instead of coke or anthracite, I have not been able to touch, whilst the use of fluxes I have simply reduced to a general theory. I trust, however, that these points will be taken up by others, since they are sufficiently important to form separate papers for discussion before the society, the principal aim of which is to advance the improvement of our staple manufactures; and this can only be done by eliciting from practical men descriptions of processes generally in use, and particularly encouraging improvements.

Pig-iron I assume as the raw material from which its staple manufactures are produced. A very large proportion of the pig-iron made in this country is converted into malleable iron. Common iron and rails are made from the cheapest descriptions of pig-iron, but for the better kinds a superior pig is used, and for the best iron refined metal alone, or mixed with charcoal pig-iron. In those works in which common iron is made, the blast-furnace manager's talent is exercised in keeping his furnace exactly in such a state as is favourable to the production of a maximum quantity of iron, with the least possible consumption of coal, or waste of the materials used. Under such circumstances, it cannot be expected that a pure iron will be produced, the effort made to obtain quantity necessarily affecting the quality.

In the manufacture of merchant bars, and iron of similar quality, pig-iron is charged directly into the puddling-furnace, and is subjected to a process called boiling. Malleable iron thus produced is much inferior in quality to that obtained from refined metal, because all the deleterious matter which the pig-iron contains being mixed up with the metal as it is being puddled, necessarily becomes more or less incorporated with it, and materially affects the quality of the puddled bar. Being alloyed with the silicated slags produced, its power of tenacity and strength becomes weakened. The waste in the puddling furnace is very large, and this loss is again seriously felt in all its subsequent manufacture, being caused by the absorption of a large portion of metallic matter by the slags produced from the impure iron. I have been told by the chief managers of two of the large Welsh works, that they had, on an average throughout the year, consumed 28 cwts. of pig-iron in the production of every ton of railway bars. In the manufacture of malleable iron, we find the cost consists of coal, labour, and the crude metal employed. If the puddling furnaces are well constructed, no material economy can be made in the present consumption of coal, and in the ordinary state of trade no reduction can be expected in the cost of labour. If, therefore, economy is to be made in the manufacture of malleable iron, it must be by a reduction in the waste of metal which is now experienced in puddling and other furnaces used in iron-works. In Wales this large waste is experienced by the use of a low carbonised white iron, containing much foreign matter; but in Scotland a similar waste results from the circumstance that the pig-iron is too highly carbonised, from which cause it has to remain much longer in the puddling furnace before it can be brought into nature. This prolonged application of the heat produces so large a waste, and entails such heavy work upon the puddler, that in Scotch malleable iron-works it is the custom to refine part of their pig-iron in order to get rid of a portion of the carbon, and thus accelerate the puddling process. The intermediate plan of refining pig-iron has been introduced between the blast and the puddling furnace, in order to clear away, as far as possible, that foreign matter which it has taken up, as well as to dissipate a portion of the carbon, but since it is absolutely necessary to keep the cost of the production of bars or rails within a certain limit, it is imperative upon the manufacturer that such operation shall entail no ultimate expense, and this can only be effected by reducing the waste of iron so low in the puddling and reheating furnaces, that the weight saved shall compensate for the expense of refining. The present plan for producing refined metal is very costly, averaging 15s. when pig-iron costs 70s. per ton. This becomes a serious charge upon the metal in its earliest stages of manufacture, and although malleable iron made from refined metal is much superior to that made from pig-iron, yet owing to the great expense of refining by the usual process of a strong blast, together with the waste experienced, and cost of fuel and labour, the prime cost of the finished bar becomes so seriously affected as to prevent its general use. I have devoted considerable time and expense to this desirable object, and I have succeeded in producing a highly decarbonised refined metal, at a cost not exceeding 5s. to 6s. per ton, including waste and every other expense. This metal produces a puddled bar with a waste of only 1½ cwt. per ton upon very common iron, and as low as 1 cwt. per ton, if the refined metal be made from strong forge pig-iron. Upon a calculation based on the manufacture of 100 tons of Welsh iron, remelted from the pig, ½ being white iron, and ½ mottled pig, the waste in refining was 90 lbs. per ton, and upon a quantity of 60 tons, drawn directly from the blast-furnace in a fluid state into my refining furnace, a loss of only 60 lbs. per ton was experienced.

Two furnaces in one of the large Welsh iron-works puddled this refined metal for twelve consecutive days, and the average waste during that period was only 84 lbs. per ton; the pig from which this iron was made had no cinder in its composition. I present for your examination several samples of this refined metal, which is produced with the greatest facility; also of the slags which result from it. The objects of this process are to reduce the loss of metal, and to use coal instead of coke as a fuel; to effect a uniform decarbonisation of the pig-iron without the use of blast, to use a chemical reagent capable of giving out oxygen during its decomposition, which, taking up and uniting with the carbon evolved from the metal, produces carbonic oxide gas, and this, acting upon the earthy compounds contained in the pig-iron, precipitates the metal contained in them, by which means I obtain very clean, pure, crystalline metal, capable of being manufactured into superior malleable iron. There are samples of malleable iron manufactured from this refined metal, also a sample of pig-iron used to produce the refined metal, several tons of which were puddled in Yorkshire and rolled into rivet iron, which was used for rivets in the *Leviathan*, and reported of excellent quality. This iron when finished experienced a waste of only 3½ cwts. per ton. By this process I refined a mixture of 15 cwts. of number 3 hot-blast pig, and 6 cwts. of cold-blast charcoal iron; the metal was puddled and rolled directly into a bar, then converted and melted into cast-steel; the files and saws which are exhibited were manufactured from this steel, and show the purity of the metal from which they have been made. The gun-barrels are made from the rough puddled bar above-mentioned, melted without conversion. These two samples were manufactured under the inspection of one of the Government officers for small arms, at Birmingham, and have been tested at the proof-house. There are several other samples of this quality of iron; it is somewhat expensive, but it is the purest iron which can be produced, having been melted and thus divested of all its foreign matter. It is a proof, also, of the great additional strength which iron acquires when the metallic particles are made to approach close to each other. My refined metal has been successfully tested for tin-plates. There are samples of this iron made in the puddling furnace, and refined with charcoal; in both instances the waste was reduced one-half when compared with pig-iron. The tin-plates manufactured from it are reported of good quality. The metal has also been found equal in quality to charcoal pig-iron when used for the manufacture of very common cutlery, called run steel. The articles before you will show that it admits of being hardened and tempered.

In making castings, whilst additional strength can be given to iron by cleansing it from earthy matter, yet care must be taken that in reducing the amount of carbon, the metal does not crystallise; a fine grain is favourable to great strength, which can only be attained by the purification of the pig-iron itself, when very strong castings are required. I recommend that the pig-iron which is used should undergo a remelting, adding such re-agents as will unite with much of the earthy matter contained in the pig, but which will not extract the carbon; such iron will make stronger castings, because the metallic particles are brought in closer contact. I find, also, from experience, that an addition of my refined metal to such purified iron will give still greater strength. Highly refined metal is not fit for castings; it is as bad as the use of hard cast-steel, because the disaggregation of the mass, arising from crystallisation, weakens the whole body.

Much has been advanced in favour of the manufacture of ordnance from cast-steel. I do not think that good and serviceable pieces of artillery can be manufactured from such metal. There is no great practical difficulty in casting a mass of steel two or even three tons weight, but the irregular crystallisation of so large a body of steel, melted in parcels of 50 lbs. in a crucible, is unfavourable to that uniform molecular structure which such castings should possess, since upon their excellence often depends the issue of a siege or action. Although wrought-iron ordnance cannot be depended upon, they are better than cast-steel, but their perfection is much impaired by the necessity of piling masses of iron together. I admit that a weld can be perfectly made, but two surfaces when oxidised can never become one amalgamated body, without the oxygen be reduced at the moment when the union is effected. Wrought-iron guns have given excellent results when fired at slow intervals, but if a continuous quick firing were kept up, I doubt their being able to withstand the shocks; they would, I think, after each round become gradually weaker through the welded surfaces.

It appears of very great importance that some means should be devised for producing a material combining the greatest strength with durability, not only for the construction of rails, but also for tubular bridges, steamships, and a great variety of similar purposes, not only to prevent loss of life, but also to secure an eventual economy. No plan appears so effective as that obtained by the union of iron and steel; such a compound metal will, I believe, furnish a better and cheaper means of effecting this great object than by the use of iron alone. Large masses may easily be obtained through the medium of the welding property of cast-steel in a fluid state. A bloom of iron is heated white hot, placed in a cast-iron mould, and fluid steel is poured against it; the effect is, that the carbon of the steel reduces the oxide on the surface of the iron, and a union like that of silver plated on copper is obtained, rather than a common weld. Two pieces of iron may thus be united, by pouring cast-steel between them when heated, forming a mass of great strength, and useful in machinery, where considerable strain is exerted, on account of the stiffness and strength of the steel being united with the toughness of the iron.

Now, more than ever, we require the means of rapid transit in our Indian possessions, to enable us to retain our supremacy in that distant portion of our empire; present experience shows us that we must take immediate measures to enable us to concentrate at any one point those means of resistance which must, in future, be kept at all times ready to protect both life and commerce. To do this, main lines of railroad must intersect the length and breadth of India, whilst light-draught steamers must open out an inland navigation which does not now exist. A compound metal of iron and steel, from its combined strength and lightness will, I believe, furnish a better and a cheaper means of effecting this great object than any which can be obtained by the use of iron alone. I beg to submit to your notice a new form of rail; it is made from a thick plate of iron and steel, united as described; the plate, when hot, is bent up into the form of a rail, the steel coating being outside; before the bar is cold it is hardened by being plunged into cold water, and tempered in the usual way; by these means are obtained, not only great combined strength by the union of the two metals, but a further addition of it, equal to 33 per cent., is made by hardening and tempering the steel, which not only prevents the rails will prevent them from setting when bent by sudden and undue pressure; they can be made of any thickness, according to the nature of the traffic; the main line might be laid with rails like the thicker model, which is equal in strength to the double-headed rail now used, which weighs 84 lbs. per yard; but many districts might only require rails like the lighter model. The advantages this rail presents are great strength, great resistance under undue pressure, a hard non-laminating surface, which will wear very much longer than those now used; but the most prominent value is their extreme lightness, combined as it is with great strength, which becomes of such high importance in the first cost of a railway. The rail of the heavy model is 36 lbs., and that of the light

one 36 lbs. per yard; if you admit for a moment that my statement is true as respects their strength and other qualities, allow me to suggest to you the valuable advantages which such a rail presents in point of economy, and the large saving made, especially to colonial railway companies, not only in the freight from England, but the more serious expense of inland transport. I will not go into the various forms which engineers might think it best to give to rails made from such material, but there does seem to me one great advantage in the mode which I have adopted to attach the rail to the chair. The model of the saddle rail is like that used on the Great Western, but it is stronger, on account of the material used. In countries where wood is cheap, a modification of this rail might be laid down very economically.

[To be concluded in our next week's Journal.]

INSTITUTION OF MECHANICAL ENGINEERS.

The general meeting of the members was held on April 28, at the Institution, Birmingham, Mr. HENRY MAUDSLAY, Vice-President, in the chair.

The secretary (Mr. W. P. MARSHALL), read the minutes of the previous meeting, and several new members were elected.

HORIZONTAL PUMPING-ENGINE.—The first paper read was a "Description of a Horizontal Pumping-Engine," by Mr. EDWARD A. COWPER, of London. A pair of horizontal pumping-engines, designed by the author, were described, erected at the Crystal Palace to raise the water from the lower reservoir or lake to the upper reservoir, in the grounds of the Palace, for the purpose of supplying the intermediate fountains. They consist of two horizontal condensing engines, each working a pump placed in a line with the steam cylinder, and connected direct to the same piston rod; the engines are coupled by forked connecting rods to cranks at right angles on the fly-wheel shaft, which is situated beyond the end of the pumps. The air-pumps and condensers are placed vertically below the horizontal framing of the engines, and are worked by bell-crank levers from the cross-heads of the piston-rods. The pump-valves are double ring-valves, guided by a vertical centre pin, having four openings for the passage of the water, and, therefore, requiring only a very small lift of the valve to give a large area of opening; and the valves shut without any concussion. The pumps are double-acting, and deliver the water into air vessels, from which the delivery pipes unite in a single main, and the combined discharge gives a very regular flow of water. The steam slide valves are worked by cams on the fly-wheel shaft, which are of such a form that the valves are moved so as to cut off the steam at an early part of the stroke, leaving the exhaust open at the other end of the cylinder to nearly the end of the stroke; by this motion a very perfect expansive action is obtained. A description was also given of a pair of horizontal pumping-engines of similar construction, erected at the Yarmouth Water-works, which are employed for forcing the water to a high level reservoir at a distance of several miles; these engines have each in addition a low-lift pump, fixed vertically under the engine and worked by the bell-crank lever, for the purpose of delivering the water from a collecting reservoir on to a set of filter beds, from which the main pumps are supplied, and force the filtered water to the high reservoir. The steam slide valves are constructed with cut-off slides on the back, worked by separate eccentrics, for working expansively. Indicator diagrams were shown, taken from the engines described, and also from a form of slide valve by which a higher degree of expansion than usual has been satisfactorily obtained from a single slide-valve worked by an ordinary eccentric. The advantages of the horizontal construction of pumping-engines for several purposes were pointed out, and the saving effected in cost of building and construction; also the increase in regularity of the flow of water obtained by coupling a pair of engines together, with a fly-wheel and cranks at right angles.

VENTILATING MINES.—The next paper was a "Description of Lemielle's Ventilating Machine for Mines," by Mr. SAMUEL LLOYD, jun., of Wednesbury. The machine consists of a large vertical drum, revolving eccentrically within a cylindrical chamber, and carrying three vanes, which are hinged to the drum at their inner edges, and at their outer edges are made to move always close to the circumference of the cylindrical chamber by means of connecting rods from a fixed shaft in the centre of the chamber. The air from the mine entering on the one side of the chamber is enclosed between the vanes of the drum in succession, by which it is carried round and discharged from the opposite side of the chamber, and thus a continuous current of ventilation is maintained; the drum is driven direct by a horizontal steam-engine of simple construction, connected to a crank upon the top. This ventilating machine is at present extensively in use for mines in France and Belgium, at some of which it has been at work upwards of three years, and the machine is there considered to possess decided advantages in efficiency and safety over the ordinary furnace ventilation. A model of the machine was exhibited, and the results were given of some experiments made with one of the machines at a colliery in the north of France.

HYDRAULIC SHEARING PRESS.—The last paper was a "Description of a Hydraulic Shearing Press," by Mr. CHARLES LITTLE, of Derby. This machine is especially designed for readily cutting up heavy wrought-iron scrap of large section, without requiring the iron to be heated for the purpose, as generally necessary. It consists of a horizontal hydraulic press, the ram of which acts against a strong slide carrying one of the cutters, the other being fixed in the frame of the machine, the whole of which forms a single casting of great strength. On opening the communication between the press cylinder and the pumps, which are worked by an engine, the ram is forced outwards, carrying with it the moveable cutter, and shearing the piece of iron placed horizontally between the cutters. By this arrangement a very great power for shearing is obtained, while at the same time the power is completely under control, and the ram can be instantaneously stopped at any part of its stroke by simply opening the escape valve from the press. The safety valve of the hydraulic press also secures it from the risk of breakage by overstrain that exists in the ordinary shearing machines driven by eccentrics or cams, where the momentum of the fly-wheel prevents a sudden stoppage of the shears being effected. The particulars were given of a series of experiments tried with this shearing press at Mr. Eastwood's works, Derby, in reference to the power required for shearing different thicknesses of iron flatways and edgeways, and also for shearing with parallel and with inclined cutters, and for punching; and a number of specimens were exhibited of the pieces of iron punched and sheared, in which the shearing had been stopped at different points, showing the complete control afforded by the machine.

After the meeting a STEAM-ENGINE INDICATOR AND WATCHMAN'S DETECTOR was exhibited by Mr. ALFRED KNIGHT, of Birmingham; consisting of an eight-day clock having two supplementary dials, made to revolve by the clock, each of them carrying a sheet of paper divided into hours, &c.; on one of these a mark is made each time that a given number of strokes is completed by the engine, which is connected by a coupling to a marking apparatus within the clock case, thus showing by inspection of the sheet whether the engine has been kept at the correct speed throughout the whole time; whilst on the other revolving sheet a mark is made by pulling a handle connected with it, recording the times at which the handle has been pulled by the watchman.

A STANDARD DECIMAL MEASURE, of steel, 30 in. in length, was shown, presented to the Institution by the late president, Mr. Whitworth; also a specimen from Mr. Whitworth of the new Decimal Wire Gauge, proposed by him in place of the different gauges hitherto in use; the new gauges are being made by Mr. Stubs, of Warrington, from standard templets, prepared by Mr. Whitworth for the purpose.

MANUFACTURE OF TIN-PLATES.

The reading of a paper on the Manufacture of Tin-Plates, and the Use of a Substitute for Charcoal as Fuel in the Finery, was the first business, after the inaugural address had been delivered, of the South Wales Institute of Engineers, an institution which it is anticipated will confer the greatest benefits upon the industry of the district. The honour of contributing the first paper has fallen upon Mr. Ebenezer Rogers, and the manner in which he performed the task he had undertaken reflects great credit upon him, and upon the body which brought it forward. The works of Herodotus, and later of Diodorus Siculus and Pliny, prove the great importance of the tin mines of this country more than 2000 years ago. Since that time they have been constantly worked, and so far from being exhausted, the tin mines of Cornwell seem now to be only beginning to open out, and to prove that the store of ore that district contains is practically inexhaustible. The official returns for 1856, compiled by Mr. Robert Hunt, show that 9350 tons of tin ore were raised in Great Britain, which is an increase upon any preceding year. About four-fifths of all the tin ore to supply the world is raised in Great Britain. The same race of men who worked the tin mines more than 2000 years since still work them, and preserve their customs and nationality.

The art of coating copper with tin seems to have been known at an early period, but the difficulty of coating iron with tin was much greater, and the process of hammering the iron into sheets sufficiently thin, and cleaning the surface, which latter work had often to be done by filing, were serious hindrances to the extensive use of the invention. The art of tinning seems to have been first practised in Bohemia, and about the year 1620 to have been introduced into Saxony. Bechmann state that "in 1670 a company sent to Saxony at their expense an ingenious man named Andrew Yarrenton, in order to learn the process of tinning. Having acquired the necessary knowledge, he returned to England with some German workmen, and manufactured tin-plate, which met with general approbation. Before the company could carry on business on an extensive scale, a man of some distinction having made himself acquainted with Yarrenton's process, obtained a patent for this art, and the first undertakers were obliged to give up their enterprise, which had cost them a great deal of money, and yet no use whatever was made of the patent which had been obtained." About 1720, works for the manufacture of tin-plates were established at Pontypool, and these seem to be the earliest of such works in England which were permanently successful.

The plans of cleaning and preparing the iron for tinning have undergone many changes in the past century. About 1720, the plan of cleaning was to scour the plates with sand and water, and file off the rough parts, then cover with resin and dip them in the molten tin. About 1747, the plates were, after being cold rolled, soaked for a week in the lees of bran, which had been allowed to stand in water about ten days to become by fermentation sufficiently acid, and then scoured with sand and water. In 1760, the plates were pickled in dilute muriatic acid before annealing, and cleaning with dilute sulphuric acid, after being taken out of the bran lees.

An improvement of great importance in this process was made about 1745 by, it is believed, Mr. Mosely, who carried on tin-plate works in South Staffordshire. The invention was the use of the grease pot, and in this department little if any improvement has since been made. The plan was introduced into South Wales in 1747 by Mr. John Jenkins, and his descendants are still amongst the principal manufacturers in the trade. The following process of cleaning and tinning is now in use at some of the best works:—When the sheet-iron leaves the plate-mill, and after separating the plates and sprinkling between each plate a little sawdust, the object of which is to keep them seperate, they are then pickled in dilute sulphuric acid, and, after this, placed in the annealing pot and left in the furnace about 24 hours; on coming out the plates are passed through the cold rolls; the cold rolling seems to give the plates too much of the character of steel, and are not sufficiently ductile; to remedy this they are again annealed at a low heat, washed in dilute sulphuric acid to remove any scale of oxide of iron, and scoured with sand and water; the plates in this state require to be perfectly clean and bright, and may be for months immersed in pure water without rust or injury, but a few minutes exposure to air rusts them. With great care to have them perfectly clean, they are taken to the stow.

The stow consists of a series of vessels, technically called the tinman's pan, the tin-pot, the washing or dipping-pot, the grease-pot, the cold-pot, and the list-pot. The tinman's pan is full of molten grease, in this the plates are immersed, and left there until all aqueous moisture upon them is evaporated, and they are completely covered with the grease; from this they are taken to the tin-pot, and there plunged into a bath of molten tin, which is covered with grease; but as in this first dipping the alloy is imperfect, and the surface not uniformly covered, the plates are removed to the dipping, or wash-pot; this contains a bath of molten tin covered with grease, and is divided into two compartments; in the larger compartment the plates are plunged and left sufficiently long to make the alloy complete, and to separate any superfluous tin which may have adhered to the surface; the workman then places the plate on a table, wipes it on both sides with a brush of hemp, and to take away the marks of the brush and give the surface a polish, dips it into the second department of the wash-pot. This last always contains the purest tin, and as it becomes alloyed with iron it is removed on to the first compartment, and after to the tin-pot. The plate is then removed to the grease-pot; this is filled with molten grease, and requires very skilful management as to the temperature it is to be kept at. The true object is to allow any superfluous tin to run off, and to prevent the alloy on the surface of the iron plate cooling more quickly than the iron—if this were neglected the face of the plate would be cracked. The plate is next removed to the cold pot, which is filled with tallow, heated to a comparatively low temperature. The list-pot is used for the purpose of removing a small wire of tin which adheres to the lower edge of the plate in all the foregoing processes. It is a small cast-iron bath, kept at a sufficiently high temperature, and covered with tin about one-fourth of an inch deep; in this the edges of the plates are dipped and left until the wire of tin is melted, and then detached by a quick blow on the plate with a stick. The plates are now carefully cleaned with bran to free them from grease. Lastly, they are taken to the sorting room, where every plate is seperately examined and classed, and packed in boxes for market.

After detailing the mode of manufacturing the iron for tin-plates, and explaining the trade marks used, he continues that one of the great items of expense in the manufacture of best iron is the cost of charcoal for fineries. About 1850 his attention was directed to the use of a substitute for charcoal in the finery, and careful thought and experiment led him to the conclusion that certain coals could be charred in such a way as to produce a mechanical structure analagous to charcoal, and, at the same time, when deprived of sulphur might be used in the finery. These experiments resulted in the manufacture of a substance which he designates "charred coal." It has been used at several of the principal manufactories in the district, and declared equal in every respect to charcoal. The coal is first reduced to small, and washed by any of the ordinary means, it is then spread over the bottom of a reverberatory furnace to a depth of about 4 in.; the bottom of the furnace is first raised to a red heat. When the small coal is thrown over the bottom a great volume of gas is given off and much ebullition takes place; this ends in a light spongy mass, which is turned over in the furnace and drawn in about one hour and a half. To completely clear off the sulphur, water is freely sprinkled over the mass until the smell of sulphuretted hydrogen ceases. The "charred coal" hitherto produced has been made on the floor of an ordinary coke oven whilst red hot, after drawing the charge of coke. The analysis of the coal from which the "charred coal" is made is—Carbon, 81·26; hydrogen, 6·31; nitrogen, ·77; oxygen, 9·26; sulphur, 1·86; ash, 2·04 =102·20. The paper concluded with a few more remarks on the iron usually employed; but we must defer this description and the discussion, which bore entirely upon the iron question, until a future opportunity.

GOVERNMENT SCHOOL OF MINES.

Mr. WARRINGTON SMYTH's lecture, on Wednesday, was on "Non-metallic Minerals." Among the silicates of lime was apophylite, so called from its peculiarity of exfoliating before the blowpipe; another denomination it had from its lustre was fish-eyes stone, or ichtyophthalmite, as well as tessellite, and ahbin, from its white colour. It crystallises in the pyramidical form, and some beautiful specimens of it are brought from the East Indies, where it is found in cavities of amygdaloid, and occasionally in aggregates. It is well known from its peculiar pearly lustre. The cleavage is perfect; the hardness is from 4½ to 5, and the specific gravity 2·3. Its colour varies, being white and green, and in some few instances pink, which last is found at Poonah. These contain silicate of lime and potash, and betray their character as hydrates by giving off water before the blowpipe, where it exfoliates and melts to a white glass. Besides the volcanic rock, it is occasionally met with in mineral veins. These rare exceptions are at Orelitzka, in the Bannat, and Andreasberg, in the Hartz; it is likewise found in amygdaloidal cavities near Aussig, in Bohemia, at Fassa, Poonah, in the hot springs in Iceland, Nova Scotia, New Jersey, and in Fifeshire, embedded in lime with fossil shells. Another mineral is the datholite, or bora-silicate of lime. The crystals of this are very small, slightly columnar, or tabular, and in druses; the hardness is from 5 to 5½; the specific gravity about 3; its tints are greyish, or greenish, with a nitreous lustre. In addition to silicate of lime, one of its constituents is boracic acid. Before the blowpipe it swells and melts, giving a clear glass. It is found in several igneous rocks in Scandinavia; the Salisbury Crags, near Edinburgh, at Glen Farlane, in Perthshire, at the Seisser Alps, in the Tyrol, at Connecticut, in the United States, and the Keneenaw Point, Lake Superior, where it is associated with native copper, as well as the iron mines of Arendal, in Norway. Meerschaum is a mineral can fairly be called amorphous. It is found in nodules; its specific gravity is 0·8. It floats in common water, and easily in sea water; it is called in all languages from this "the skum of the sea;" and from being found floating on the water for a considerable period, was imagined to be portions of this hardened. It is in general whitish or greenish; the streak is more lustrous than the external surface. Its character is unctuous, and it adheres strongly to the tongue. Several varieties have been examined by chemists, and by some it has been called a carbonate of magnesia. The analyses of Berthier and Scheerer have, however, proved the contrary. This substance is of considerable value when pure, but very little if impure. Some quantities are found in Spain, but its principal locality is near Kutaiah, in Asia Minor, the place where the Hungarian exiles were sent to by the Sultan. He was of opinion that no European of sufficient mineralogical reputation had hitherto investigated the peculiar phases under which it was found. He had himself on two occasions intended to have gone there, but from various circumstances he was unable to effect his object. From what he had gleaned from the Turks, it appeared it was discovered in nodules in the sandstone, then simply packed in barrels for exportation to Germany and elsewhere; it is then boiled in wax or oil; the larger portions are cut for various purposes, principally for pipe heads, and the chippings are afterwards pressed with water, and from this are made what are called the "massa pipes," which are quite different in their properties to the others. In Spain and Portugal it is said to be employed in the manufacture of fine china. They ought to know that both this mineral and graphite were very good of their kind, but would fetch a very indifferent price when they were impure. The next mineral he would allude to was talc; this, however, had a different name in scientific language to that of commerce, where it was called mica. It crystallises in the prismatic form. It occurs sometimes very small, at others in large masses, as the talcose slates, as well as in argillaceous schists, forming talc on the surface. It is met with in a few localities in Cornwall and Devon, in Angleses, and in North Wales in the neighbourhood of Dolgelly, where gold has been found; and it is a singular fact that the precious metal is only met with in those rocks which have a talcose structure. Before the blowpipe it exfoliates and changes its character. It is used for various purposes, and the Chinese simply subject it to calcination, and employ it as a medicine. Steatite is slightly harder than talc, is a pseudomorphous mineral, is unctous to the touch, and hardens before the blowpipe, so that lately it has been employed as gas-burners, and has the property of not being melted at a great heat. It is called by the Germans "speck stein," or bacon stone, on account of its appearance. Some varieties of the pot stone, or *lapis ollaris*, are used in the East Indies for the purpose of forming dishes, and what we might term crockery ware. Connoisseurs in London and Paris purchase it in Italy in the shape of vases and other ornaments; they do not, however, denominate it by the common term of pot stone, but call it ancient lava, though any one acquainted with the subject must be aware this is a false nomenclature. Soap stone, closely related to the last, contains a small quantity of alumina, and is found in serpentine rocks. This takes a fine polish, and is used for ornament. It varies in colour from a pale green to a dark green, and often has a mottled appearance. There are, as well as the noble serpentine, larger masses of serpentine rocks, which are found in Asia Minor, Greece, Saxony, the Island of Elba, and round the Mediterranean, where they play an important part. Picrolite is similar to Baltimorite and Williamsite; this last gives traces of nickel. Another important mineral is chlorite. Its hardness is from 1 to 1½, specific gravity 2·9; this is called "peach" by the miners, and is found associated with veins of copper and tin, scarcely ever with regular lead lodes, if at all. In the western districts, whenever the miners come upon the peach in a vein the consider it a good indication, and that there is likely to be something of value to follow it. And here he would again impress upon them, for practical purposes, that an intimate knowledge should be acquired of those minerals which were found to be associated with or near metallic veins.

GOVERNMENT SCHOOL OF MINES.—The lecture by Dr. PERCY to working men, on Monday, was a continuation of that on "Fuel." The action of heat upon the air was shown, and the difference between this heated or otherwise was explained. The method of making coke was described, the general yield being in round numbers from 60 to 70 per cent. The North of England coals are all coking, and if placed in a close vessel, or subjected to smothered combustion, will form a coherent mass, while that which is non-coking becomes merely what the French term a calcined coal. The lecturer then alluded to the method of curing smoky chimneys, and observed that generally those who experimented on them began at the wrong end; they commenced at the top, without any regard to the bottom. Several furnaces were then described, and illustrated by models and diagrams. On Friday Mr. Warington Smyth commenced his introductory lecture, which treated of the general physical character of minerals; this is to be followed by one on the ores of iron.

COLLIERY OPERATIONS—"BORING."

The value of a really efficient system of boring cannot be overrated, as it enables the strata to be explored at a much cheaper rate than would be possible were any other method resorted to; whilst the results obtained are quite as reliable as the most expensive mining operations. By this system of exploration being adopted, the question as to whether coal exists near London at a workable depth could be definitely settled, and certainly without a greater outlay than 2000*l.* or 3000*l.* It may be argued that the geological reasoning as to the probable existence of a mineral is sufficient to justify any extent of mining operations; but to the capitalist the more practical test of boring give far greater confidence. Both in England and on the Continent the number of patents taken for boring apparatus is very large, the earliest English patent appearing to be that of James Ryan, dated 1805; John Good patented an improvement in 1823; Robert Breart in 1844; Messrs. Mather in 1845; Wm. Gard in 1847; Kind in 1850; Wm. Schottlander in 1852; Worthington and Allman in 1854; Colin Mather in 1854; Tolhausen in 1856; and Hughes in 1856; in addition to which are the processes used by Fauvelle, of Perpignon; Thompson, of Philadelphia; and Lane, of Wilderz, neither of which are patented in this country. By far the most important of these inventions are those of Mather, Kind and De Wendel, and Lane; and priority of these, again, is undoubtedly due to Kind and De Wendel, who attain immense depths at an extremely small cost. A company is said to be in course of formation for introducing the continental system of boring into this country, and from it the most favourable results may be expected.

Attention was first drawn to Kind's apparatus in a paper read before the Institution of Mechanical Engineers, at Birmingham, in 1854, by Mr. S. H. Blackwell, when the system was declared to remedy all the defects of the processes previously in use in England. The chisel is not permanently attached to the rods, but simply raised to any required height by them, and allowed to fall by its own weight. The members of the institution seemed well pleased with the invention, and Mr. Blackwell exhibited a tabular abstract of registers kept of borings on Kind's system, showing that in one instance a depth of 355 yards, at a cost of 1*l.* 0*s.* 11*d.* per yard, which appears to be about the average. Mr. Siemens testified to the success of the process, that the work was accomplished with great precision, and that the mode was considerably superior in quickness and economy to the ordinary method of boring: the average cost of deep boring was not more than one-half. In Jan., 1855, an attempt was made to introduce the new system to more extensive public notice, but it appears that no material progress was made, since there has been even to the present time little heard of the system.

The chief improvement in Mr. Kind's apparatus was the introduction of the free-fall apparatus, for he was thereby enabled to adopt improvements which would, under other circumstances, have been useless. The object of the free-fall apparatus is to enable the operator to release the chisel at any moment from the rods, and thus, by allowing its free fall, to do its work at the bottom of the bore-hole. This apparatus consists of a pair of tongs capable of laying hold of a bar of iron in which the chisel is fixed, and these tongs open and shut by means of the action of the water in the hole on a disc of leather during the up and down motion of the rods. The operation proceeds as follows:—The rods, to the lower end of which the free-fall apparatus and chisel are attached, are lifted to the height requisite for the subsequent fall of the chisel; during this upward motion, the water in the bore-hole presses against the upper side of the leather disc, by reason of the resistance it meets with by being drawn through the water, but the moment the motion of the rods is attempted to be reversed or lowered, the pressure of the water against this disc is also reversed, causing it to slide a little way on the rods. This motion of the disc is made to effect the opening of the tongs holding the end of the chisel, which is then disengaged, and free to fall without the rods and free-fall apparatus, which then follow at a more moderate rate of descent, and again take hold of the chisel, in order to raise it for another blow. Nothing but actual experience can show the important effects accomplished by the free-falling of the chisel. In the first place, it enables the great mass of iron rods to be replaced by others of a lighter construction, as they are much less severely handled in this than in the old process; wood is the material accordingly employed, which, by reason of its buoyancy in the water, is, comparatively, of little or no weight on the lever, even in the deepest boring, provided water be present; the labour or power, is consequently greatly diminished, as by Mr. Kind's process the weight to be raised each time is merely that of the chisel, together with the small amount of counterpoise necessary to keep the rods down in the water, while the whole weight of the chisel becomes effective in its fall. A much more important advantage of the use of the free-fall apparatus, however, arises from the less liability it occasions to those serious accidents from the breakage of the rods in the hole, always attending upon works of this nature under the old mode, when of any considerable extent; this will be readily understood from what has been stated, of their not having to sustain those severe shocks and concussions, and also from their always being in a position of suspension from the point of support on the end of the lever, and never resting on their lower end in the bore-hole, whereby they are liable to be buckled up, or broken, from the superincumbent weight of the upper or the lower portion.

The core-boring is managed by having a sort of crown tool, which cuts all round the periphery of the hole, leaving an annular space and solid central block, or core, which core is broken off and brought to the surface by means of a particular form of clack. Instead of bringing up powder for examination, this apparatus then can produce a cylindrical block of the rock which is being bored through, as we have seen in the specimen cores, giving all the indications in the dips of the beds, and their exact character, that could be obtained by the sinking of a shaft. This operation requires considerable care in order to realise to the full extent the advantages to be derived from the exhibition of a perfect sample, by showing the direction and amount of the inclination of the bed, or strata; that it is effectually accomplished is satisfactorily established by some cores brought up from depths exceed 1000 feet, as well as by the public accounts of the numerous and very extensive works that have, during the last 10 years, been successfully completed under Mr. Kind's system and direction.

The circumstance which has hitherto prevented recourse being had to boring when the strata beneath a given surface is desired to be known is the consideration that the cost increased in such an extraordinary degree with the depth, and within the last few years it has been gravely asserted that the ordinary cost of boring was 7*s.* 6*d.* per fm. for the first five; 15*s.* for the second five; 21*s.* 6*d.* for the third, and so on; so that at the depth of 175 fms. the cost would be nearly 25*l.* per fm., which is absolutely incorrect, if we are to place any reliance in Mr. Blackwell's figures, which show that the total cost of such a boring would not exceed 200*l.*, or less than would have to be paid for the last 10 fms., according to the above calculation. It may be stated that the reason of Kind's system incurring so small an extra expense in deep sinking, is that the length of rods does not cause any greatly increased strain upon the machinery at surface, that the rods are not liable to damage, and that pumping is unnecessary. The rods being usually made of wood, bound round with iron, they can be adjusted to the weight of the water so as almost to float, so that very little power is required to raise the chisel, which falls by its own weight, and an extremely small power is required, whatever may be the depth. The lecture recently delivered at the Bristol Mining School, by Mr. H. Mackworth, Government Inspector of Mines, was well received, and it is to be regretted that this subject receives so little general attention.

IRON MANUFACTURE IN ENGLAND.

It will be an interesting investigation to discover and record the many unsuccessful attempts which have from time to time been made to introduce entirely new methods in the manufacture of iron, or to improve upon the methods already in practise. One of the most important of these attempts, made again and again, through a long series of years, had for its object a fundamental change in the reduction of iron from its ore; none other than the substitution of hydrogen in place of carbon, as the reducing agent. As early as Dec. 22, 1792, we find John Barber reducing iron ores by means of "inflammable air from a retort or retorts," which is injected through pipes with or without the air blast. His specification is a sad jumble of absurdities, looked at from the modern chemist's point of sight; but all we are curious to record is the fact, that so early the use of hydrogen (inflammable air) had been proposed.—Philip Taylor, Aug. 18, 1826, injected carburetted hydrogen into the blast furnace, and John Samuel Dawes, Dec. 8, 1835, introduced pure hydrogen; the gas being obtained by decomposing steam, by passing it through red-hot iron pipes, containing coke or cinders. The carbonic acid formed was separated by passing the impure hydrogen through water or lime water. Three years afterwards—July 10, 1838—William Barnett patented the manufacture of iron by the use of carburetted hydrogen or coal tar, introduced either alone or in conjunction with an air blast. The same method has been proposed with various modifications by many subsequent patentees, but it is unnecessary to pursue further a hitherto barren idea. Many are the propositions for reducing the rich ores of Lancashire and Cumberland (consisting of peroxide of iron) to a reguline or metallic state, by the process of cementation. We will note the earliest and most important of these. On April 18, 1791, Samuel Lucas patented "bringing iron ore and also calx of iron into a metallic state without first rendering either of them fluid." He directs the ore to be put into a melting pot mixed with charcoal, or other carbonaceous matter, the pot made tight, and heated in a furnace. The result is described as "steel, and sufficiently converted to make cast-steel, and may be run into ingots." William Neale Clay, Dec. 19, 1837, proposed a process differing from that of Lucas principally in matters of detail. The ore and charcoal (coke, cinder, &c.) are put into retorts similar to gas retorts, and properly heated. The reduced iron is afterwards puddled. The same patentee improved upon his process in a second patent, dated March 31, 1840. Sir Francis Knowles, in his patent of July 4, 1849, describes the reduction of iron directly from the ore by the use of carburetted hydrogen and volatile hydro-carbons, and also by cementation with charcoal. But this notion need be pursued no further.

We have lately heard much about using steam in the manufacture of iron. The idea is a very old one. John Barber, in his patent, April 21, 1773, for a machine "and apparatus thereunto belonging, which by fire, water, and steam, will purify fossil coal, extract metals from their ores, and collect their particles when volatilised by heat," describes the use of steam. The steam is obtained, and delivered by pipes at great velocity into the furnace, at various heights above the air blast. The same inventor, in a subsequent patent, dated Dec. 22, 1792, describes an improvement in his first invention, the steam in the latter modification being injected "by a pipe or pipes, through an aperture or apertures made or left in the hearth" of the furnace. In a patent granted May 26, 1840, to Sir John Josiah Guest and Thomas Evans, the use of steam is described, the steam being applied both in the refining and puddling furnaces, being "forced upon or into, or in contact with, the metal." "A blast of highly-heated steam," "in place of the hot or cold air blast," is the essential novelty in the patent of Angier March Perkins, dated March 16, 1843. Many subsequent inventors improve upon or modify the inventions last described; but we must hasten to other matters.

The running of the crude iron from the blast furnace to the refining or puddling furnace, instead of casting and afterwards reheating pig-iron, is laid claim to by many patentees. Messrs. Jones, Foster, Barker, and Jones, lay claim to it in their patent of Sept. 8, 1832. It is described by John J. Guest in his patent of Jan. 31, 1833; and again by Messrs. Powell and Ellis, in their patent of April 24, 1841, and by how many others since it is unnecessary to ascertain.

The hot blast appears to have been perfected by James Beaumont Neilson, who describes it in the specification of a patent granted to him Sept. 11, 1828. The patent was declared valid after long litigation. It is, however, worth while noting, that although the patentee describes the carrying of his invention into effect, by passing the air through heated vessels, he does not limit himself to any particular method, but appears to claim in the broadest manner the heating of air to be supplied to furnaces. Yet a patent for what appears to be nearly the same thing was granted nearly a year before to Thomas Botfield. This patent bears date Jan. 2, 1828. The invention described by Mr. Botfield is "for causing or obtaining a blast of atmospheric air sufficient to smelt" pig-iron "from ironstone." The blast is produced by means of rarefied air, gas flame, or heated air from an oven or fire place, and is to be applied in or to a blast furnace, cupola, or air furnace." The use of a hot blast in making iron is subsequently described by Charles Pierre Devaux, in his patent of Oct. 8, 1835, and by George Crane, in his patent dated Sept. 8, 1836. The last patentee uses the hot-blast in conjunction with anthracite or stone coal, as a fuel: and states that the iron made according to his invention is equal to "iron obtained by the aid of vegetable charcoal."

The application of the waste heat of blast furnaces has occupied the attention of the ingenious through a long series of years; and has been the subject of almost innumerable patents. It will suffice if we notice the earliest of these. In his patent, dated March 4, 1788, Robert Gardner describes a variety of furnace arrangements, and states that steam-boilers may be heated by passing the waste heat from the furnaces described, around, through, or under the boilers. Moses Teague, in his patent dated Jan. 17, 1832, proposes to heat ores and minerals before introducing them into the furnace or cupola, and thereby to economise heat, by heating the said ores and minerals by the waste heat ordinarily discharged into the air from the furnace or cupola. Since this time many other methods of utilising the waste heat of iron furnaces have been proposed.

The conversion of cast-iron into malleable iron by the process called annealing, originated with Samuel Lucas, who patented his invention May 30, 1804. This ingenious and valuable invention, although largely practised in Birmingham and Sheffield, has never yet attained the success it deserves, and will be certain to have, when the prejudice which it has ever had to contend with has passed away. By this process articles made of cast-iron are converted into wrought-iron, or as it is invariably called in the neighbourhood, malleable iron (pronounced by the workmen *maleable* iron.) So firmly has this groundless distinction taken root, that by malleable iron is now ordinarily meant in the language of commerce annealed cast-iron. The notion is prevalent that the so-called malleable iron is still cast-iron, only softened. The term *annealing*, which is applied to this process, fosters this erroneous notion, and hence, as we have said, this beautiful invention, although half a century old, has yet to receive the attention it deserves. Let us then state at once, that the annealed cast-iron, or malleable iron, is iron of the finest quality; that it is not only cast-iron, but the purest wrought-iron (using the term *wrought* in its conventional sense), and that only charcoal iron, some foreign irons, and the choicest samples of British iron, approach it in purity. Let us explain this invention. Articles are cast in cast-iron—certain kinds of cast-iron, well known in commerce, being alone used—and the articles thus cast are embedded in powdered hematite, or peroxide of iron (Cumberland ore), and heated for several days. By this treatment the articles are found to become soft and malleable; the cast-iron, in short, has become wrought-iron. The change has been effected by the oxidation of the carbon of the cast-iron. This has been produced by the oxide of iron, in which the articles were embedded, yielding oxygen to the carbon of the cast-iron, and thereby removing it by oxidation. How unlike does this process appear to the puddling process, and yet to the eye of the chemist it is the same. In the one case the carbon is removed from the cast-iron by means of oxide of iron, formed on its exterior, being forced or kneaded into the metal, and there supplying oxygen to the carbon; in the other case the oxide of iron is kept for several days in contact with the outside of a piece of iron, and by a slow, but most effectual action, the oxygen of the oxide and the carbon of the cast-iron are brought into union, and the decarbonisation of the iron effected. If this ingenious process were properly appreciated we might have articles of wrought-iron incomparably more complex and delicate than any which are possible by the process of forging, and at much less expense. If the appearance of casting be objected to, let it be got rid of by filing or other method of treatment; after the annealing the article may be bent or forged, or subjected to any treatment that ordinary wrought-iron may be subjected to. In short, there seem to be but

two solutions of the neglect of this interesting process. One exists in the unfounded pretentions which are common respecting the properties of the annealed iron; the other is that there is an abstract merit on account of its difficulty in producing articles by forging, which can be produced much easier by casting. Time will correct the ignorance in which the former error is founded, and wear out the prejudice which is at the bottom of the latter.—*Birmingham Journal.*

AUSTRALIA.

Our correspondent's letter, and the private advices from Melbourne, are to March 15. Being in reply to two mails from England—those of December and January, which were necessarily of a different tenor as regarded the monetary and commercial affairs here—they are more than ordinarily interesting; and it is gratifying to find that the colonists generally were invigorated by the monetary change for the better which the January mail announced, and most persons in Melbourne were looking forward to a prosperous year.

A dissolution of the HAINES Ministry has occurred, and a new administration has been formed under the presidency of Mr. O'SHANNASSY, a change it was considered which would work to the satisfaction of the colony. It is designated as the end of the ascendancy of the old leaven in the Government, and that the days of circumlocution offices were fast coming to a close in Victoria. The accession to office of the new Ministry was regarded as the dawning of a pure democratic executive, and that the power of the "squatters" was terminated, while the people will now obtain the reforms in the representation to which they are entitled. Under the control of the new men in power, many of the crying abuses in the Government offices would be remedied, and with a reformed Legislature, with an increase of Members in the Assembly, a more just consideration of the national expenditure was relied upon, and especially on the financial question of borrowing for railway works. The intelligence of the improved state of the London money market has caused railway contractors to talk more confidently, but nothing definite would be known on this important point until the new Ministry announced their policy. In the meantime, the period for receiving tenders for the construction of the two trunk lines had been extended for a short period.

The companies constituted by private enterprise for the making of branch lines have issued extracts from their engineers' reports, by which it appears the profits are likely to be very large. The Melbourne and Hobson's Bay and the St. Kilda companies continue to be approvingly managed. The first-named was still paying at the rate of 14 per cent. per annum to its shareholders, and the latter was equally remunerative.

From Sydney, whence our letters are to March 11, we learn that the elections for New South Wales had terminated, and Parliament was summoned to meet on the 23d of that month. Nothing material had occurred in the political circles since the departure of the February mail. Commercial matters had been temporarily affected by the crisis in this country, but the mercantile houses had shown themselves fully equal to such an emergency, and confidence had, therefore, been fully restored.

Adelaide advices reach to March 11, and we find that this colony was not in receipt of the over-due London January mail. Thus, while the Melbourne merchants have been able to reply to the January letters, those of Adelaide have only been in a position to answer those of December, again, as on several previous and consecutive cases, losing a course of post. Sydney, also, was in the same dilemma on this occasion.

The financial position of the colony is shown to be sound. The balance in the treasurer's hands at the close of the year was 225,226*l.*, according to the returns issued by the Government of the colonial revenue and expenditure. Commercial matters presented a more favourable appearance than might have been expected, considering the depressed state of trade in the adjoining colonies. The harvest was got in well, and reported as fully an average crop. Large consignments of wheat and flour were being made to England, India, and the Mauritius.

The yield of minerals was increasing. New mining localities were being opened up, and the mining interests generally were assuming great activity. Coal is reported to have been discovered at Copio, near Port Lincoln.

Telegraphic communication between Adelaide and Melbourne was expected to be opened throughout in the course of April.

AUSTRALIA—MINING INTELLIGENCE—COLONY OF VICTORIA.—In the present condition of mining in this colony, fluctuations in the quantities of gold produced are to be looked for, the cause being attributable less to any deficiency in the natural wealth of our gold fields than to the unsettled habits of the miners, and the very wasteful manner in which they work. New discoveries of auriferous deposits are constantly being made, and, if none of them equal in richness the gold fields which were first worked, the proofs which they furnish of the dispersion of the mineral treasures over almost the entire colony are highly satisfactory, as indicating an illimitable field for the present and future employment of capital and labour. Indeed, there is already ample evidence to show that the generations which exist will all be exhausted long before the gold deposits of Victoria have ceased to yield a profitable investment for the labour of the working man. But that labour must be more economised than it is at present. Now, it would scarcely be an exaggeration of fact to state, that of the thousands who live by gold digging a very large proportion waste their time and what money they may have in joining in rushes, and in the idle and unproductive habit of "shepherding." It is true that the waste caused by the ignorance or recklessness of the miners has, since their day, profitably employed their successors, but, at any rate, men laboured, if not to such advantage as should have accrued to their exertions, still with some benefit to themselves. It must also, no doubt, be taken into consideration that on the gold-fields of Forest Creek, Bendigo, and Ballarat, where the Victorian miners first commenced their operations, there was gold everywhere. Still the constant recurrence in the present day of rushes to localities which had previously been tested in the modern fashion, and pronounced worthless, proves to some extent, certainly, that if the old plan of working was wasteful, it at any rate caused the real wealth of the diggings to be developed. Co-operative associations are on the increase; and, indeed, it is only by such organisation that quartz mining and deep sinking can be carried on.

Some excitement has been caused at Melbourne by current reports of a lead of great richness having been discovered on a "second bottom" in the Castlemaine district, but the reports referred to require confirmation. The general mining intelligence is devoid of interest. At Maryborough, in the old main lead, some good patches have been struck, and the rush near Havelock has turned out well. Some good ground has also been opened up on the Daisy Hill-road. Dunolly is improving, the new ground at Jones's Creek and Cochran's being spoken very highly of. Ballarat has begun to show signs of reaction, and the escorts thence are, from all accounts, likely to be on the increase. The falling off in the yield of the Ovens district is so marked, and so continuous, that it is to be wondered at that no corresponding movement of the population takes place. The Omeo district, which still affords employment for its limited number of inhabitants, has been almost flooded out by the late rains. Among the new phases of mining history is that of the proposed introduction on a great scale of associated enterprise in the working of some of the old fields. The district of Bendigo is about to be secured in the possession of an unfailing supply of water by the enterprise of Mr. Emmett, supported by other capitalists. The whole of Golden Flat is to be excavated, and converted into a vast reservoir for the supply of the municipality and of the miners, under an agreement which secures to the township many immediate advantages, as well as the ultimate possession of the works. Mr. Emmett proposes to send the enormous body of earth which he will have to excavate—extending over from 80 to 100 acres—through the process of washing within a given time, and to carry on simultaneously the work of laying down pipes for the supply of the town of Sandhurst. Similar projects, but in a less forward state, are on the *tapis* for the supply of other districts, and another year will witness great changes in this respect.

The following is a list of the vessels freighted with the precious metal which have sailed from Port Phillip since February 1:—*London*, 2611 ozs.; *Roxburgh Castle*, 50,267 ozs.; *Morning Star*, 4783 ozs.; *Sydenham*, 26,669 ozs.; *Simla*, 33,515 ozs.; *Invincible*, 16,181 ozs.; *Swiftsure*, 80,050 ozs.; *Medway*, 9593 ozs.; *Othona*, 5142 ozs.; *Hebe*, 5548 ozs.; *Indemnity*, 11,130 ozs.; *Pericles*, 1359 ozs.; *London*, 1000; *Jupiter*, 5467 ozs.; and the *Red Jacket*, 40,234; making 293,549 ozs., equal to 1,174,196*l.*, without considering the freight of the *Emeu*, which has just brought home 204,864*l.*, so that altogether there is a total of 1,379,060*l.* from this port alone.

NEW SOUTH WALES.—The returns from the various gold-fields in this colony had steadily increased, and those from the Southern gold fields are 50 per cent. more than last year. The increase on the receipts of the two months of the present year is 4760 ounces in favour of 1858. For the first week in March the escorts have delivered 4176 ounces of gold dust.

SOUTH AUSTRALIA.—The mining interests of this colony are progressing most satisfactorily. The returns from the Burra Burra continue as large as heretofore, and the shares are quoted at 135*l.*, notwithstanding a reduction in the price of copper of this company had taken place from 107*l.* to 95*l.* per ton. The Bon Accord had commenced operations with a good staff of miners for the preliminary work, and the local committee express themselves confident of the success of the enterprise. Important new discoveries had been made on the surface of this property. In fact, as we have before frequently explained, it is clear that mining operations in South Australia are in an infantine state, and we are glad to find our views fully confirmed by so practical a miner and competent a judge as Mr. Bentham Neale, Member of the Legislative Counsel, who, at a recent public meeting held in the colony, expressed his conviction that "mining was in its infancy in South Australia. They had nothing at work but one monster mine (Burra Burra), the most productive and the most profitable in the world. He believed there were many Burra Burras in the colony, and one of them, the Bon Accord, was now likely to be worked with vigour, and would show, he had no doubt, that the Burra Burra lodes did not stop short at the boundary of that property. With reference to other mines about to be opened, he believed they would prove successful, and that another year would show a wonderful change in the mining world of the colony." The Wheal Friendship and the Bremer are beginning to be worked, and the mining localities of Angaston, Port Lincoln, and Onkaparinga, were highly spoken of, and generally reported as very rich, especially in the district of Angaston.

THE DUKE'S TOMB—A CORNISH SPECIMEN.—Mr. E. J. Treffry, of Place, Fowey, Cornwall, writes—"The great Duke's sarcophagus was wrought and polished by steam power in the parish of Luxulyan, in this county, in the field in which the huge 'boulder' stone of porphyry, weighing upwards of 70 tons, nearly the whole of it above the ground, had been standing for ages. It is not a figure of speech, but a fact, that the Continent had been searched in vain for a sepulchral stone sufficiently grand for a sarcophagus that should contain the mortal remains of the great Duke. That stone was at last found in Cornwall, and the whole of the work was executed by workmen in the employ of the Treffry estate, whose representatives were intrusted with the matter throughout. The cost of this unparalleled tomb was 1100*l.*"

CORNISH MINE PHOTOGRAPHS—No. XXIX.

MINERS' SUPERSTITIONS.

Perhaps the inhabitants, particularly the vulgar, of every country are more or less imbued with these impulses of the human mind. It is found to pervade savage life, where it is mistaken for religion; it is, therefore, not at all surprising that such veneration is accorded to the unhallowed rights and barbarous customs as we hear are practised by the primitive races of mankind. In civilised life they are characteristic either of a weak understanding or uneducated mind: as a rule, it may be set down that the more ignorant a people are the more are they devoted to superstition. Even where education is given, the ofttold, long-cherished tales, handed down from family to family, become so engrafted and naturalised as to be almost identified with their very nature, requiring the experience of years of instruction to wean the descendants, and to eradicate their belief in these fancies. Nor are they entirely confined to the uneducated classes; frequent instances occur in which superstition reigns predominant in spheres where we should have supposed errors so glaring would have been expunged or impossible. It is to this force of habit we may attribute the remnants of silly credulity still to be found amongst our otherwise shrewd, well informed, generally religious, and well-conducted mining population. The legends of many a foolish, idle tale are still told with the greatest decorum by old folks as having been told them by their sires; they, as in duty bound, asserting their entire concurrence in the persuasion of their truth, inspiring awe and dread into the younger portion of the community. Though the relaters do not attempt to account for the probability of their stories, they would consider it heresy to doubt them. It is gratifying, however, to find that this gross infatuation is gradually on the decline, and will, it is to be hoped and believed, ere long become finally extinct. The credence in the existence of witches and "wise men," we are sorry to confess, is far from annihilated: these rascally professors generally gain such an ascendency over their dupes, that they dare not reveal their complaints of extortion, or the knaves so dexterously manage their dealings as to keep out of the grasp of the law; yet when opportunity has offered the magistracy have certainly most properly punished such instances with condign disgrace. Belief in witchcraft is not the only hallucination to which the miner is subject; some of his are very peculiar. The most popular is the faith in certain mysterious personages, termed "pixies," or "small people." They seem to be a kind of masculine fairies, but, unlike the softer sex of these diminutive folk, they delight in nothing but mischief. We have heard otherwise sensible, clever men declare with earnestness, and with a warmth which evidenced conviction, that they have been deceived by this agency—that though they have been in their own paddocks, only a few yards from their homesteads, and at other times could not be mistaken, yet being "pixey laden" (spell-bound) they had been unable to find their way, until some one came to relieve them by breaking the "charm"—that during this unaccountable influence, though they could not see these extraordinary personages, yet they could distinctly hear their laughs and jokes at the sufferer's dilemma. The reador may well exclaim in wonder, Can it be possible that such superstition is extant at this day? We say, Yes; and to this hour in some districts. The fairies, too, have their share of devotees, but these are more amongst the agricultural than the mining portion of society, the rings of the midnight revellers being supposed to attest the realities of their presence. In the mining districts no herbage of sufficient luxuriance is to be found to tempt these fairy dancers to trip the light fantastic toe.

If a thousandth part of the fables could be authenticated, ghosts might be pronounced plentiful; there is scarcely a lone churchyard or abbey ruins where they have not been seen. White owls are not uncommon, and the goat-sucker, or night-jar, is frequently met with, uttering their dismal and discordant cries. These may in some measure account for ghostly appearances, which are firmly accredited by thousands. Some years since, a farmer's son, near Penzance, met a justly-deserved castigation whilst attempting a practical joke in this character. A miner returning from the town, being pot valiant, was determined to combat his ghostship, even if he were Satan himself. On meeting with this customer, whom he verily believed to be Satan come for him (the clown being wrapped in a bullock's hide, with horns and tails), he resolved to fight hard rather than be taken to Pandemonium before his time; in doing which he so used his staff as nearly to kill the would-be thought supernatural personage, to the great joy of the neighbourhood where these pranks had been a source of continual annoyance and alarm. The fool was also very properly punished severely by the authorities, and the miner commended for his pluck.

Amongst the imaginary influences affecting miners more immediately, may be mentioned dowsing, or a belief in the divining-rod, and flames of fire issuing from metallic veins. These are somewhat akin to the fallacies foisted on and believed by the public in the late animal magnetism and table-turning delusions. These, like their compeers, have been exploded as childish by scientific and practical men, and the impossibility of inert matter acting as supposed by any inorganic power displayed; yet they are so strenuously advocated and defended as correct and true by others of great celebrity as practical miners, and able, well informed men. Many of the principal mines in the county are said to have been discovered by these agencies, though we have never yet met with a well authenticated case, they being generally what the son had heard father say what his father had seen!

We have often been tempted to try the efficacy of the dowsing stick: whether it arose from our organ of veneration not being sufficiently developed, or from any other cause, the rod would not act in our hands. We also witnessed the feat performed by one of the most celebrated dowsers in Cornwall, who boasts of having discovered scores of lodes by the stick. On this occasion he proclaimed with certainty a lode of some kind existed in a spot indicated by the obedient dowsing rod. The mining company who listened to the tale, and were weak enough to believe in its augury, as may be supposed, lost the capital they expended to prove whether the lode were there or not. If people of this standing believe such childish tales, the poor miners may well be excused.

Dreams, too, come in largely for their share of patronage, as may be supposed, by the female portion; for this the authority of the Bible is quoted, and, with people so much addicted to credulity, this argument is conclusive. It is really amusing to hear the tales of the wonderful discoveries which have been made during dreams, and to see with what implicit reliance the dictates of nightly visions are followed. Not long since we were pointed out a place by an old man, who, with all the eloquence he could command, assured us his father had dreamt there was gold in that place, and had actually commenced an adit for its discovery, which cost the poor old fellow great labour and money he could ill spare, of course, in vain. "Yet," added our informant, "it will be found by somebody" Strange as it may appear, it is no less true, this spot has been since proved to be a very rich and valuable copper mine. So much for the old man's dream; he made a mistake in the metal, and did not take the method of double *entendre* used by the Delphine oracle, or he might have been equally correct with that celebrated ancient authority.

All the forgoing fancies seem more or less common in all parts of England, as well as with the mining population of Cornwall, and not to be wholly confined to the ignorant. One of their own superstitions is peculiar to miners, that is universal amongst them—their objection to any person under any pretence whatever whistling underground, for fear of raising the spirits. Strange as it may appear to a novice, the objection is always made, and, of course, is always readily complied with, or the men make most decided signs of discontent and uneasiness. Reasoning with them on the subject is useless; they will not permit it by any person on any account. Only a few weeks since we were underground with a most intelligent and really very clever mine agent, when for a moment forgetting ourselves, we indulged in a stave, when we were at once asked if we had ever been underground before, and were real Cornish, and yet dare to whistle there! "Because, if you intend to do that, you may go over the mine by yourself; you do not get my company." We were at once silenced, and did not again indulge in the schoolboy's solace, lest we should pay too dear for our whistle.

These errors, however they may be regretted, are innocuous, compared to the practices of reputed fortune-tellers and witchcraft. The arch villains who practise these arts, when once they obtain celebrity, drive a capital trade on the credulity of the population; the chief business being the patronage of the softer sex, who, as of yore, are as curious as Pandora, and display an equal anxiety. One of the most celebrated of these wizards was Johnny Hooper, whose name, though the fellow has been some years in his grave, is still spoken of as that of a wonderful man; many of his predictions and discoveries being still firmly believed by the peasantry. Johnny was a "character" in his day, and has consequently left a name. We warrant there is scarcely a person in Cornwall seven years of age who has not heard of Johnny Hooper.

Born in one of the most out-of-the-way places in the county, and as profoundly ignorant as it was possible a human being could be, yet withal possessed of that half-witted low cunning which is frequently and correctly expressed by the proverb—he is more R than F—this crafty knave contrived to eke out a tolerable existence without (to him the greatest dread of life) hard work. In our boyhood we remember him living in a little cottage on a wild moor in the parish of Ladock, near Michell. We were of a large party of young folk who out of joke visited Johnny, and stole his grinding-stone, challenging Johnny to name the delinquent, which he was wise enough to decline; thus, at all events, showing him in his true colours, that he was shrewd enough to evade an exposure by substituting a joke, and that he knew nothing of the affair, but that we were bent on mischief; so Johnny was hailed as a wiser man by us, at least.

We were anxious to ascertain an authentic account of this notorious character's antecedents and history, and to learn by what means he had acquired his celebrity and ascendency over his fellows. His fame was co-extensive with the boundary of the county; people from all parts of it resorted to him for advice. If anything were lost Johnny was applied to for the discovery of the delinquent; if any deemed themselves the victims of bad luck, or under the influence of witchcraft, he was the oracle consulted—with shame it must be owned, in too many instances by parties who ought to have known better. Undoubtedly, the fear of an appeal to this personage has frequently been the cause of purloined property having been discovered, and the articles stolen being replaced or given up, not unfrequently by the agency of this fellow, who has been known to mulct double fees for compounding and settling robberies.

We found Johnny's history to be pretty nearly as follows:—He was one of those fellows, found in every parish, who have a natural taste for idleness; consequently, always out of work and in rags, ready to receive a penny to do anything not involving labour. At a Christmas party in the village, Johnny, then a youth, was arrayed as a gipsy woman (a character he was well adapted to represent), and having been placed in a dimly-lighted room, and being first well drilled by a young lady of the party as to what he was to say to one of the guests who consulted him (a young, handsome, and rich widow), the story conjured up surprised the widow, who was delighted beyond measure, and declared the gipsy to be gifted with superhuman powers, as she had told her all the circumstances of her past life, therefore she could not doubt her ability to name her future husband, as she had done, though she had never dared to aspire to such a thought herself. This essay brought the fortune-teller 5*s.* After a drilling by another of the party, Johnny detailed a soft but tender tale to a young lady, describing her devoted admirer, and promising all sorts of fine things, for which he was further rewarded by a like sum, as well as 2*s.* as his fee. Johnny was cunning enough to see his way clear; a light had burst upon him; he started as a professional fortune-teller, with considerable success. To ratify his ability, it is said he stole a horse, which he tied to a tree in a wood (Arrallus Wood). The horse being missed, Johnny was applied to for advice; he demanded three hours for study, at the end of which time, in ambiguous terms, he announced the possibility of the horse being found in the situation named; search proved the oracle correct. The news spread like wildfire, and brought this knave into an extensive practice, which he enjoyed to the end of a very long life, fully serving his end and aim—a course of sheer idleness.

Unfortunately the belief in fortune-telling still exists to a certain degree, this is to be lamented, but strenuous endeavours are being adopted by all classes of educated persons and all sections of religious bodies to exterminate this foul blot, as well as the other superstitious persuasions still extant. We firmly believe they will ere long be successful, they have excellent material on which to exercise their philanthrophic endeavours, no people being more tractable or more willing to learn any instruction intended for their real benefit, which we hail these efforts to be, and trust, in a few years, there will be found an entire absence amongst these people of "Miners' Superstitions."

G. HENWOOD.

FOREIGN VINEYARD ASSOCIATION.—The ordinary half-yearly general meeting was held at the offices, Regent-street, on April 29,—Dr. Beattie in the chair. The report stated that the commercial crisis which had commenced prior to and continued throughout the period for which their report deals, has necessarily affected the amount of sales; the augmentation in cost prices, alluded to in the last report, has also gone on increasing, consequently the profits on ordinary or current daily business have not been so great as heretofore. An advantageous opportunity having occurred for the relinquishment of the contract with the proprietors of the Rousan estate, the directors deemed it advisable for several reasons to avail themselves of it, and they hope the shareholders will be satisfied they have acted judiciously when they learn that a profit of 2000*l.* has been effected. The 232 original shares remaining unsold at the last meeting have been readily disposed of at 5*l.* premium, which the directors led the shareholders to expect might be obtained, thereby proving the confidence of the proprietary and the public in the stability of the company. The directors recommend that a dividend, at the rate of 10 per cent., be declared, payable on and after May 14. Of the balance, 2089*l.* 17*s.* 6*d.*, 500*l.* is to be invested in the name of the trustees as a reserved fund, in accordance with the resolution of the shareholders present at the general meeting in 1857, and 1589*l.*, the larger portion of which is payable by instalments by the proprietor of the Chateau Rousan estate will be dealt with hereafter as may be deemed most advisable for the interests of the company. The Chairman observed he would detain the meeting only a very short time while he made a few remarks on the several paragraphs in the report. The favourable change which had taken place in the value of money would, no doubt, have a beneficial effect on the operations of the company, and if he might judge from the amount of sales this month, already 4646*l.*, there is every prospect of this being realised. The Customs Returns for 1857 showed there had been less consumption of foreign wines and spirits in 1857 than in 1856. There was a great advantage gained by premiums on shares, and some of these had been disposed of in partial settlement of the paid-up shares given to the promoter. If more capital became necessary, shares would be issued *pro rata* at par. The directors did not think it prudent to recommend a bonus this half-year, but as a large sale of the company's Cantenac clarets, the produce of 1857, had already been made at a very handsome profit, there was every reason to believe a dividend equal to the present, and also a bonus, would be paid in Nov. The directors felt the great responsibility they were under to the shareholders for the careful supervision of the affairs of the company, as well as the evil consequences attending upon laxity and misrepresentation on the part of directors of several joint-stock companies. The report was then adopted, and a dividend, at the rate of 10 per cent. on the past half-year, declared. Messrs. W. H. Palmer and J. Slack, the retiring directors, were re-elected. The sum of thirty guineas was awarded to the two auditors, Messrs. Heath and Foster, for their services during the past audit. The usual complimentary votes to the Chairman and other directors terminated the proceedings.—In conformity with the notice, the meeting was then made special, for the purpose of considering an alteration in the Deed with reference to the appointment and qualification of an auditor, and a resolution was passed giving power to elect auditors, although not shareholders; this, after some discussion, was carried, subject to confirmation at a subsequent meeting.

ASIA MINOR CENTRAL RAILWAY.—A prospectus has just been issued of this important undertaking. We lately published an account of a project in the course of being matured, by which China could be reached in 16 days, and by the route proposed by this company parties leaving London can arrive at Bombay in 12 days 4 hours and 26 minutes. The immense importance of bringing this country within reach of Bombay in so short a time is incalculable, and the following plain account, pointed out by a map, must prove that the promoters have not made any exaggerated statement. By the existing lines and proposed line of communication, the distance from London to Costendjie is 1711 miles; from Costendjie to Samsoun, 431 miles; from Samsoun to the Persian Gulf, 1265 miles; from the Persian Gulf to Bombay, 1487 miles: making a total distance of 4894 miles, including 1940 miles at sea, estimated to be performed, at only 10 miles per hour, in 194 hours; and 2953 miles by land, at 30 miles per hour, in 98 hours 26 minutes. Total time occupied from London to Bombay by this route, 292 hours 26 minutes, or 12 days 4 hours and 26 minutes. Had such a means of communication been in existence at the late unfortunate outbreak in India, hundreds of valuable lives and millions of money would have been saved to this country. In a commercial view it is of equal importance. The official returns of the English Consul at Samsoun show that 320,000 tons of merchandise passed through the port in the year 1856, the greater portion of which was carried to or from Sivas or places further in the interior; but assuming one moiety to have been carried the whole distance, and the other moiety various shorter distances, equal on the average to half the entire distance, and that the charge per ton per mile for carriage was 9*d.*, the total amount which must have been paid for the transport of the merchandise was 1,620,000*l.*, which, whilst conferring such increased facilities to commerce, will be equal to 16½ per cent. on the outlay, after making allowance for working expenses and the reserve for the redemption of the capital. An absolute concession for 99 years has been granted by the Sublime Porte for the construction of the line from Samsoun, the principal port on the Black Sea for the trade of Asia Minor, to the city of Sivas, in the direct route to the Persian Gulf, through a well-populated district, accommodating in its course Mersivon, Amassia, Zilleh, and Tocat, all places of considerable importance. The line between Samsoun and Amassia will command a large traffic, and practically demonstrate the great value of the undertaking; it will, therefore, be the first portion to be constructed. The existing traffic, although so large, will be much increased by the development of the resources of Asia Minor, and by the greater use of the ancient highway from the Black Sea to the Persian Gulf. Amongst the advantages secured to the company are—The transfer without charge of the land for the railway; the privilege of working, for their exclusive benefit, all coal mines on Government lands within 30 miles of the line; the option of purchasing, at prices to be fixed by a Government commission, all coal mines on private property within the like distance; the exemption from import duty of all materials for the construction and use of the railway; the security against any railway competition within 30 miles. The authorised capital is 4,625,000*l.*, one-third to be provided by the Ottoman Government. The amount to be immediately created is 3,000,000*l.*, in 150,000 shares of 20*l.* each, 50,000 for the Ottoman Government, and 100,000 for general distribution, upon which a guaranteed interest of 7 per cent., both on deposit and calls, is secured, and the surplus profit beyond that rate to belong to the proprietors. Mr. Price, a contractor of well known experience and resources, has undertaken to construct the line and stations, and provide the rolling stock, for 3,750,000*l.* The directors are gentlemen of the highest respectability and experience, including the Lord Mayor of London and the Chairman of the Peninsular and Oriental Company, and there can be little donbt that the capital for so desirable an undertaking will be speedily subscribed.

GUTTA PERCHA BANDS, TUBING, &c.—

Our BANDS, carefully MANUFACTURED from the VERY BEST GUTTA PERCHA only, are considerably CHEAPER, and, when fairly worked, are far more DURABLE than LEATHER. Can be had in lengths of 100 or 120 feet without a joint, are easily joined or repaired, and are, when worn out, re-purchased by us at about one-third of their original cost. In the event of a break down, a band of any size can be supplied within a few hours of receipt of order. The present prices are as under :—

Bands ⅛ in. thick and upwards to ½ in. .. 2s. 0d. per lb.
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West-street, Smithfield, London, E.C.

VULCANIZED INDIA RUBBER MACHINE BANDING

is not affected by wet, heat, or cold; does not stretch nor slip on the pulleys, HOSES for BREWERIES, &c., will not impart taste, smell, or colour; also, for conducting, or steam purposes. VALVES, WASHERS, PACKING, &c., IN STOCK.—Prices and testimonials on application to DODGE and GRANDONATI (late Dodge, Bacon, and Co.), 44, St. Paul's Church-yard, London, E.C.

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warranted good by the maker, shave well for twelve months without grinding.
MAPPIN'S 2s. RAZORS, shave well for three years.
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MAPPIN BROTHERS, QUEEN'S CUTLERY WORKS, SHEFFIELD; and No. 67, KING WILLIAM STREET, CITY, LONDON; where the LARGEST STOCK OF CUTLERY in the world is kept.

MAPPIN'S ELECTRO-SILVER PLATE & TABLE CUTLERY.

—MAPPIN BROTHERS (Manufacturers by Special Appointment to the Queen) are the only Sheffield makers who supply the consumer in London. Their London Show Rooms, 67 and 68, KING WILLIAM STREET, LONDON BRIDGE, contain by far the LARGEST STOCK OF ELECTRO-SILVER PLATE and TABLE CUTLERY in the world, which is transmitted direct from their manufactory, QUEEN'S CUTLERY WORKS, SHEFFIELD.

	Fiddle Pat.	Double Thread.	King's Pat.	Lily Pat.
12 Table Forks, best quality	£ 1 16 0	£ 2 14 0	£ 3 0 0	£ 3 12 0
12 Table Spoons, best quality	1 16 0	2 14 0	3 0 0	3 12 0
12 Dessert Forks, best quality	1 7 0	2 0 0	2 4 0	2 14 0
12 Dessert Spoons, best quality	1 7 0	2 0 0	2 4 0	2 14 0
12 Tea Spoons, best quality	0 16 0	1 4 0	1 7 0	1 16 0
2 Sauce Ladles, best quality	0 8 0	0 10 0	0 11 0	0 13 0
1 Gravy Spoon, best quality	0 7 0	0 10 6	0 11 0	0 13 0
4 Salt Spoons (gilt bowls), best qu.	0 6 8	0 10 0	0 12 0	0 14 0
1 Mustard Spoon, best quality	0 1 8	0 2 6	0 3 0	0 3 6
1 Pair Sugar Tongs, best quality.	0 3 6	0 5 6	0 6 0	0 7 0
1 Pair Fish Carvers, best quality.	1 0 0	1 10 0	1 14 0	1 18 0
1 Butter Knife, best quality	0 3 0	0 5 0	0 6 0	0 7 0
1 Soup Ladle, best quality	0 12 0	0 16 0	0 17 6	1 0 0
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Complete Service	£10 13 10	£15 16 6	£17 13 6	£21 4 6

Any article can be had separately at the same prices.

One Set of Four Corner Dishes (forming eight dishes), £8 8s.; One Set of Four Dish Covers (one 20 in., one 18 in., and two 14 in.), £10 10s.; Cruet Frame (four glass), 24s.; Full Size Tea and Coffee Service, £9 10s. A Costly Book of Engravings, with prices attached, may be had on application.

	Ord. qual.	Medium qual.	Best qual.
Two dozen Full Size Table Knives, Ivory Handles	£2 4 0	£3 6 0	£4 12 0
1½ dozen Full Size Cheese ditto	1 4 0	1 14 6	2 11 0
One Pair Regular Meat Carvers	0 7 6	0 11 0	0 15 6
One Pair Extra Sized ditto	0 8 6	0 12 0	0 16 6
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One Steel for Sharpening	0 3 0	0 4 0	0 6 0
Complete Service	£4 16 0	£6 18 6	£9 16 6

MESSRS. MAPPIN'S table knives still maintain their unrivalled superiority; all their blades, being their own Sheffield manufacture, are of the very first quality, with secure ivory handles, which do not come loose in hot water, and the difference in price is occasioned solely by the superior quality and thickness of the ivory handles.
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European and American Steam-Ship *Indiana*, Gravesend, March 3, 1858.
SIR,—Having to leave Southampton at short notice, also with strange hands in the Engine Room, I was not able to devote much time to your PATENT REGULATING AIR-DOORS; yet as I was obliged to steam round with *three* instead of *four* boilers, I am happy to say I WAS ABLE TO KEEP STEAM, with your invention, MUCH BETTER THAN I EVER COULD BEFORE. The smoke was cut off in a few seconds after every charge of fuel.
Your's, respectfully, C. RICHARDSON, Chief Engineer.
Mr. J. Lee Stevens.
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The MARCO POLO of this line sailed with the steam-ship ROYAL CHARTER from Melbourne, and arrived in Liverpool eight days before her.
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FOR MELBOURNE,
Forwarding Passengers by Steam to various Ports in
AUSTRALIA AND TASMANIA.

Ship.	Register.	Burthen.	Captain.	Date.
SALDANHA	1563	3000	WATTS	5th June.
GREAT TASMANIA	2140	4500	BREWER	5th July.
CHAMPION OF THE SEAS.	2480	4500	M'KIRDY	To follow.
OCEAN CHIEF	1092	2500	BROWN	To follow.
LIGHTNING	2090	4500	BYRNE	To follow.
MARCO POLO	1625	3500	CLARKE	To follow.

The above line is composed of the LARGEST, the FINEST, and FASTEST MERCHANT SHIPS in the WORLD, and have been built by the most celebrated builders of the day, including M'Kay, of Boston. They are commanded by men who have already rendered themselves famous, and their equipments and accommodations are unequalled by any line of ships afloat.
The Black Ball Line has had the distinguished honour of a visit from Her Majesty the Queen, who was most graciously pleased to say that she had no idea there were such magnificent ships in her merchant navy.
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To the consignment of H. T. Wilson and Co., Melbourne.

Ship.	Captain.	Register.	Burthen.	To sail.
BEEJAPORE	DRENNING	1676	4750	May 20.
SIMONDS	J. LEAVITT	1203	4000	May 27.
RED JACKET	M. H. O'HALLORAN..	2460	5000	June 20.
WHITE STAR	T. C. C. KER	2360	5000	July 20.
GOLDEN ERA	H. A. BROWN	1556	4200	—
MERMAID	E. DEVEY	1320	4000	—
SHALIMAR	J. R. BROWN	1432	4000	—

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We have now used the Glass Tubes for Water Gauges, made by Mr. Tomey, for three years, and can recommend them to railway engineers. I have not seen any equal to them. ALEX. ALLAN, M. Inst. C.E., Locomotive Superintendent.
Are used on the London and North-Western, Eastern Counties, Midland, and all the principal railway lines in Great Britain. ENOCH TOMEY, Canal-street, Perth.

BRICKS.—Messrs. OATES AND INGRAM

inform brick makers on an extensive scale that their PATENT SOLID BRICK MACHINE is now THOROUGHLY and EFFICIENTLY TESTED, and are prepared to OFFER the following counties to the trade, in districts, either by ROYALTY or PURCHASE:—Middlesex, Surrey, Sussex, Essex, Kent, Norfolk, Suffolk, Cambridge, Oxford, Gloucester, Hertford, Berks, Bucks, Huntingden, Devon, Cornwall, Dorset, Wilts, Hants, and Isle of Wight.
With this PATENT MACHINE the ordinary surface clay requires no preparation whatever, whilst that of a rocky nature has merely to be passed through rollers in the usual WAY, AND THENCE, WITHOUT ANY TEMPERING, INTO THE MACHINE, FROM WHICH THE BRICKS ARE REMOVED DIRECT TO THE KILN IN A STATE READY FOR BURNING.
The MACHINE is now making UPWARDS OF THIRTY BRICKS PER MINUTE at the works of Messrs. KIRK and PARRY, Government contractors, Fort Elson, near Gosport; and also at the Patent Solid Brick Works of T. WELLS INGRAM, Oldbury, near Birmingham.
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